3RD EDITION

MODERN Developing METHODS

for

PRINTS AND FINE GRAIN NEGATIVES

PRICE FIFTY CENTS

THE EDWAL LABORATORIES, INC.

"Soaking" the Film

After the tank is loaded and the lid securely on, all operations can be carried out in daylight, if the tank is really light-tight. If the tank is very small or is of the "apron" type so that there is not much room between the emulsion and the apron or the next layer of film, it is advisable to soak the film in plain water for 2 or 3 minutes before development to prevent adherence of air bubbles and "relax" the film, which if badly curled will sometimes buckle enough to touch the back of the next film layer. *With the larger spiral groove tanks such as the one illustrated, there is plenty of room between successive layers of film and this "pre-soaking" is a waste of time.* Indeed, there have been cases where pre-soaking the film in tap water has led to coarse grain and fogged film, because the tap water contained traces of chemicals which got into the developer and over-activated it. If by chance a fine grain developer is contaminated in this way, it should be immediately thrown out, because it will fog subsequent rolls of film developed in it.

Development

The developer should be cooled (or warmed) to the temperature at which development is to be carried out. The temperature should be measured accurately with a good thermometer which should be held in the solution for a minute or so before taking a final reading.

The developer should be poured into the tank as rapidly as possible as shown in the accompanying illustration. After development is complete, the developer should be poured out as rapidly as possible and the stop bath poured in immediately. Developing time should be measured from the moment you *begin* pouring developer into the tank to the moment you *begin* pouring it out. If the tank is filled and emptied as rapidly as possible this method of timing will result in correct development. This is the timing method that is used in working out developing times of all Edwal formulas.

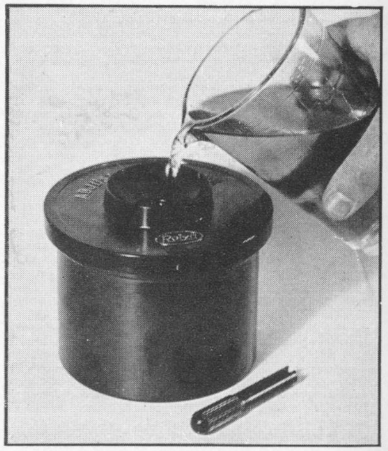


Fig. 3—Pour the developer into the tank as rapidly as possible.

If a bakelite tank is used the variation in temperature during development is seldom more than a degree during the average developing time, and for practical purposes may be neglected. Metal tanks, however, are better heat conductors than bakelite and the temperature may vary several degrees, especially in warm weather. For this reason it is advisable during development to keep a metal tank in a large dish of water which is at the same temperature as the developing solution. If this is not possible, the temperature should be measured at the beginning of development and again toward the end and the developing time actually used should be based on the average temperature rather than the temperature at the beginning.

Agitation

The film should be agitated vigorously at first by swishing the reel back and forth in the tank (Fig. 4). During development, agitation for 10 seconds every 2 or 3 minutes is sufficient.

A mechanical agitator can be used if desired. If the mechanical agitator rocks or twirls the entire tank back and forth, the developing time should usually be cut 10% below the time given for hand agitation. If the mechanical agitator swishes the reel back and forth inside the tank, the developing time can be cut 20%. These figures have been determined for spiral groove tanks of the type shown in the illustrations. For other types of tanks, comparative tests should be run before applying these percentages. If the film is insufficiently agitated, uneven development results, and, with 35 mm films, streaks running down from the sprocket holes often appear in the emulsion.

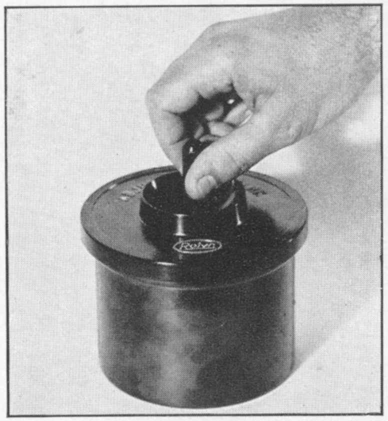


Fig. 4—Agitate by twirling the reel back and forth in the solution.

The Rinse Bath

The best rinse bath for film is distilled water, or plain water which contains 8 or 10 drops of glacial acetic acid per liter. A few crystals of citric acid can be used in place of acetic if this is desired. A strongly acid stop bath should not be used if the developer contains much carbonate or sulphite, as most developers do. If an emulsion that is saturated with

Table I—COMMON DEVELOPING AGENTS

Trade Names	Chemical Name	Reduction Potential	Speed of Oxidation by Air		Precautions (See Note) In Handling	
			SOLID	IN DEVELOPER	DRY POWDER	IN DEVELOPER
1. *Amidol*	Diaminophenol hydrochloride	35	Rapid	Very Rapid	Stains Toxic	Non-staining Toxic
2. *Metol,* Elon, Rhodol, Pictol, Monotol, Veritol	Mono-methyl para-aminophenol sulphate	20	Slow	Rapid	Toxic	Toxic
3. *Pyro,* Pyrogallol	1, 2, 3-trihydroxybenzene	16	Slow	Rapid	Stains	Stains
4. *Chlorhydroquinone* Edwal C. H. Q.	1, 4-dihydroxy-2-chlorobenzene	7	Slow	Medium	Non-toxic	Non-toxic
5. *Pyrocatechin* Edwal Catechol	1, 2-dihydroxybenzene	7	Slow	Medium		
6. *Gradol*		6	Slow	Medium	Toxic	Toxic
7. *Kodelon*	Para-aminophenol hydrochloride	6	Slow	Medium	Toxic	Toxic
8. *Glycin* Monazol	Para-hydroxyphenylamino acetic acid	1.6	Medium	Slow	Non-toxic	Non-toxic
9. *Hydroquinone*	1, 4-dihydroxybenzene	1	Slow	Medium	Non-toxic	Non-toxic
10. *Paraphenylenediamine* Edwal Diamine-P	1, 4-diaminobenzene	0.4	Medium	Slow	Stains Toxic	Stains Toxic
11. *Orthophenylenediamine* Edwal Orthamine	1, 2-diaminobenzene		Slow	Slow		

Note: The developing agents mentioned as "toxic" will produce a severe skin rash on people who are allergically sensitive to them. Most people are not sensitive, however, and can handle any developer without trouble. Those listed as "non-toxic" have little or no tendency to cause rash, as far as is now known. Those for which no information is given have not been used widely enough to establish definite information. A person who is sensitive to metol, may not be sensitive to Kodelon or Diamine-P, etc. However, persons who are sensitive to all the so-called "toxic" agents can usually employ a film developer such as Edwal-102 which contains Monazol. All common developing agents are toxic in the true sense of the word, for they are poisonous if actually eaten.

the sensitometric worker are of little or no use in practical photography, because it is seldom that two batches of film produce exactly the same gamma even when developed in the same manner; and no developer which is used over and over produces the same gamma on two successive rolls of film. The attainment of an exact value of gamma is of little importance because the latitude inherent in printing papers and methods of developing them more than compensates for small differences in negative contrast.

Density

If a negative has a heavy silver deposit so that it transmits relatively little light, it is said to be dense or "heavy." On the other hand if there is little silver in the image, the negative is called "thin." Density is controlled almost entirely by exposure. In fine grain work, especially with 35 mm film, it is advisable to make several exposures of different lengths (e.g. ⅛, ¼, ½ normal and full normal with Edwal-12) and then use the thinnest negative that has the necessary detail and gradation. If a negative is too thin, print quality is apt to be poor.

Density is also controlled to some extent by developing time, because more silver can be deposited in a long time than in a short one. However, prolonged development always builds up the silver deposit in the dense portions (highlights) much more than in the thin portions (shadows) with the result that very strong, unnatural contrast results. Sometimes very bad under-exposures can be saved by developing 45 minutes in Edwal-12 or 60 minutes in Edwal-20 but this should never be done unless the film is known to be badly under-exposed. The grain is always made coarser by prolonged development.

Unsatisfactory Negatives: Tracing Causes

A thin negative may be the result of under-exposure or under-development. In deciding which type of intensification would help most, it is necessary to determine which type of under-timing caused the thin image.

Users of 35 mm film can do this by comparing the edge-numbering on a roll of film in question with those on a normally developed roll. These edge-numberings and brand markings are exposed normally at the factory, so if they are thinner on a particular roll of film than on a normally developed roll, the thinness of the negatives is due to under-development. However, if negatives are thin and the edge-numbering is perfectly normal, the thinness is due to under-exposure. The edge-markings of different manufacturers differ in density, and sometimes vary over long periods of time, so that when making such a comparison films of the same make and of nearly the same expiration date should be used.

Negative Quality

The term negative quality is rather indefinite and has been used to cover a number of things such as gradation (the exactness with which tones in the negative represent light values in the subject), tone separation (whether closely related tones are distinctly separated or "run into each other"), etc. In judging whether negative quality is good or bad the ultimate test is whether or not the negative will give a good print. If the negative quality obtained from a developer is consistently bad, the user should try another formula.

The majority of the developers now on the market produce fairly good negative quality, though there are some that ought never to have been invented and there are others which disappoint their users because impossible claims are made for them.

All the present Edwal formulas will give good negative quality if correctly used.

FOR THE BEGINNER

Lest the beginner be appalled by the prospect of keeping half a dozen different developers on the shelf, it should be said that a single developer will give reasonable satisfaction in most amateur work, especially if a little care is used to regulate the developing time according to the lighting and type of subject. In northern United States or Canada, Edwal-12 or Edwal-20 are recommended, the choice depending on the fineness of grain necessary. In the Southern States, Mexico, or tropical regions, Minicol or Edwal-32 are more suitable.

FOR THE ADVANCED WORKER

As the photographer acquires experience in handling and judging light, increases his knowledge of films, paper emulsions, etc., he becomes more critical of his own results. He will then appreciate the desirability of using the particular developer that suits the type of lighting and the final result he wants. Specific suggestions along this line are found in Chapter VII.

EDWAL-10

For enlargements to 6 or 10 diameters (maximum emulsion speed).

	Metric	*U. S. Units*
Water	**900 cc**	**30 ounces**
Metol (Elon, Pictol)	**5 grams**	**75 grains**
Fine Grain Sulphite	**100 grams**	**3 1/3 ozs.**
Monazol	**5 grams**	**75 grains**
Borax	**10 grams**	**150 grains**
Water to make	**1 liter**	**1 quart**

This developer is recommended for use in place of the metol-hydroquinone-borax type developers. It contains Monazol which is more active than hydroquinone in the presence of weak alkalis such as borax, and hence gives much better gradations in the middle tones and high-light regions. It is recommended for fine grain development of large negatives where a relatively high density is needed. With miniature negatives it can be used with half normal exposure or even less. Suggested life: 8 to 12 rolls of film (35 mm or 2¼ x 3¼) per quart.

DEVELOPING TIMES IN MINUTES FOR EDWAL-10

(See end of chapter for classification of films)

Temperature	Class I	Class II	Class III	Class IV	Class V	Class VI	Class VII
65° F. (18°C)	8	10	12	15	18	22	26
70° F. (21°C)	6	8	10	12	15	18	22
For temperatures above 75° F. add one measure of Edwal Thermo Salt per pint and develop:							
75° F. (24°C)	6	8	10	12	15	18	22
80° F. (27°C)	5	6	8	10	12	15	18
85° F. (30°C)	4½	5	7	8	10	12	15

EDWAL-12

For enlargements to 15 or 20 diameters (maximum emulsion speed).

	Metric	*U. S. Units*
Water (distilled)	**900 cc**	**30 ozs.**
Metol (Elon, Pictol)	**6 grams**	**90 grains**
Fine Grain Sulphite	**90 grams**	**3 ozs.**
Diamine-P	**10 grams**	**150 grains**
Monazol	**5 grams**	**75 grains**
Water to make	**1 liter**	**1 quart**

(Available in prepared form)

Edwal-12 gives best results with ½ the normal exposure for miniature size film based on the American film manufacturers' speed ratings. Full normal exposure usually produces a negative which is not only too dense but is grainier than necessary.

DEVELOPING TIME TABLES FOR EDWAL-12 AND SUPER-12

***Times for developers containing Thermo-Salt are printed in bold face type.**

Where no times are given in the table, development under those conditions is not recommended.

Developer (and its condition)	Method of use	Temperature °F	°C	Developing Times, In Minutes (By Film Classes)													
				I		II		III		IV		V		VI		VII	
					*		*		*		*		*		*		*
Edwal-12 (fresh)	Regular or Replenishment (1st film)	65	18	8	**10**	10	**12**	12	**15**	15	**18**	18	**22**	22	**26**	26	**31**
		70	21	6	**8**	8	**10**	10	**12**	12	**15**	15	**18**	18	**22**	22	**26**
		75	24	5	**6**	6	**8**	8	**10**	10	**12**	12	**15**	15	**18**	18	**22**
		80	27	—	**5**	—	**6**	—	**8**	—	**10**	—	**12**	—	**15**	—	**18**
		85	30	—	**4**	—	**5**	—	**6**	—	**8**	—	**10**	—	**12**	—	**15**
Edwal-12 (used)	Regular ** or Replenishment	65	18	10	**12**	12	**15**	15	**18**	18	**22**	22	**26**	26	**31**	31	**37**
		70	21	8	**10**	10	**12**	12	**15**	15	**18**	18	**22**	22	**26**	26	**31**
		75	24	6	**8**	8	**10**	10	**12**	12	**15**	15	**18**	18	**22**	22	**26**
Super-12 (fresh or used)		80	27	—	**6**	—	**8**	—	**10**	—	**12**	—	**15**	—	**18**	—	**22**
		85	30	—	**5**	—	**6**	—	**8**	—	**10**	—	**12**	—	**15**	—	**18**
Edwal-12 (fresh)	Dilution (all film)	65	18	16	**20**	20	**24**	24	**30**	30	**36**	—	**44**	—	**52**	—	**62**
		70	21	12	**16**	16	**20**	20	**24**	24	**30**	30	**36**	—	**44**	—	**52**
		75	24	10	**12**	12	**16**	16	**20**	20	**24**	24	**30**	30	**36**	—	**44**
Super-12 (fresh)		80	27	—	**10**	—	**12**	—	**16**	—	**20**	—	**24**	—	**30**	—	**36**
		85	30	—	**8**	—	**10**	—	**12**	—	**16**	—	**20**	—	**24**	—	**30**

****When used by the regular method the developing time should be increased 5% for each roll of 35 mm. film (60 square inches) or equivalent area of other film after the first 10 rolls (600 square inches) have been developed. The recommended life is 12 to 15 rolls per quart but 20 rolls can be developed if necessary.**

DEVELOPING TIME TABLES FOR EDWAL-20 AND SUPER-20

***Times for developers containing Thermo-Salt are printed in bold face type.**

Where no times are given in the table, development under those conditions is not recommended.

Developer (and its condition)	Method of use	Temperature °F	Temperature °C	Developing Times, In Minutes (By Film Classes) I		II		III		IV		V		VI		VII	
					*		*		*		*		*		*		*
Edwal-20 (fresh or High Energy Replenished) *Super-20* (fresh or High Energy Replenished)	Regular or low energy Replenishment (1st film) or all film by High Energy Replenishment.	65	18	12	15	15	18	18	22	22	26	26	31	31	37	37	44
		70	21	10	12	12	15	15	18	18	22	22	26	26	31	31	37
		75	24	8	10	10	12	12	15	15	18	18	22	22	26	26	31
		80	27	—	8	—	10	—	12	—	15	—	18	—	22	—	26
		85	30	—	6	—	8	—	10	—	12	—	15	—	18	—	22
Edwal-20 (used) *Super-20* (used)	Regular ** or low energy replenishment (film after the first)	65	18	15	18	18	22	22	26	26	31	31	37	37	44	44	52
		70	21	12	15	15	18	18	22	22	26	26	31	31	37	37	44
		75	24	10	12	12	15	15	18	18	22	22	26	26	31	31	37
		80	27	—	10	—	12	—	15	—	18	—	22	—	26	—	31
		85	30	—	8	—	10	—	12	—	15	—	18	—	22	—	26
Edwal-20 (fresh) *Super-20* (fresh)	Dilution (all film)	65	18	24	30	30	36	—	44	—	52	—	62	—	74	—	88
		70	21	20	24	24	30	30	36	—	44	—	52	—	62	—	74
		75	24	16	20	20	24	24	30	30	36	—	44	—	52	—	62
		80	27	—	16	—	20	—	24	—	30	—	36	—	44	—	52
		85	30	—	12	—	16	—	20	—	24	—	30	—	36	—	44

**When used by the regular method the developing times should be increased 10% for each roll of 35 mm. film (60 sq. in.) or equivalent area of other film after the 7th. Maximum life: 15 to 18 rolls per quart if used up in 3 to 4 weeks. If stored for long periods or if exposed to air a great deal, maximum life is 10 to 12 rolls per quart and the 10% increase should be started after the 5th roll instead of the 7th.

EDWAL-20

	Metric	*U. S. Units*
Water (distilled)	**900 cc**	**30 ounces**
Gradol	**5 grams**	**75 grains**
Fine Grain Sulphite	**90 grams**	**3 ounces**
Diamine-P	**10 grams**	**150 grains**
Monazol	**5 grams**	**75 grains**
Water to make	**1 liter**	**1 quart**

(Available in prepared form)

Edwal-20 is intended for the production of negatives which can be enlarged to 25 diameters or more. With care in processing negatives can be produced which are capable of enlargement to 60 diameters without objectionable grain.

Edwal-20 is intended for use with full normal exposure on 35 mm film, 50% more than normal on larger rolls or packs, and twice normal on cut film and plates. Edwal-20 produces a yellowish brown silver deposit and negatives should appear rather thin on visual inspection. Suggested life: 10 to 12 rolls of 35 mm or 2¼ x 3¼ film per quart. (Maximum: 15 to 18 rolls if used within a few weeks.)

If stored for long periods or if exposed to air a great deal, the 10% increase should be started after the 5th roll instead of the 7th.

Edwal-20 can be used by the Replenishment Method or the Dilution Method just as with Edwal-12. However, in the Replenishment Method with Edwal-20, the developing time should be increased 10% after the 6th roll and an additional 10% after the 9th roll (which amounts to putting the film in the next higher developing class). After the 9th roll no further increase of developing time is necessary.

If Edwal-20 is used by the Dilution Method, thiocyanate should not be added, because with any "super fine" grain developer, the use of thiocyanate causes a considerable increase in fog.

EDWAL-20 HIGH ENERGY REPLENISHER

Many photographers, especially those who use large negatives, prefer the snappy negatives produced by fresh Edwal-20 to the somewhat softer ones produced by used Edwal-20 or by Edwal-20 replenished by the method described for Edwal-12 (called the "low-energy" replenishing method to distinguish it from the "High-Energy" method described here). For such users a "High-Energy" replenisher has been worked out. The formula is:

EDWAL-20 HIGH ENERGY REPLENISHER

	Metric	*U. S. Units*
Water	900 cc	30 ounces
Gradol	4 grams	60 grains
Metol	2 grams	30 grains
Fine Grain Sulphite	90 grams	3 ounces
Diamine-P	10 grams	150 grains
Monazol	5 grams	75 grains
Water to make	1 liter	1 quart

(Available in prepared form)

After a 35 mm roll (or 60 square inches of any film) is developed in fresh Edwal-20, replace 2 ounces of used Edwal-20 with 2 ounces of the above replenisher solution. Pour the 2 ounces of replenisher into the Edwal-20 storage bottle while the film is in the developer, and when development is finished, pour in the used developer from the tank until the bottle is full, discarding any used developer remaining in the tank. This restores the original full energy so that the next roll is developed for the same length of time (if of the same film class). The table on page 36 gives the developing times for fresh Edwal-20 and for Edwal-20 used with "High-Energy" Replenisher.

Replenishment with the High Energy Replenisher may be carried on until 2 quarts of replenisher have been used up for each quart of fresh Edwal-20 originally used. The developer should then be discarded and a fresh batch of Edwal-20 made up. The high energy replenishing method allows the use of less exposure than the low energy method but does not give as fine grain.

EDWAL-32

A non-staining super-fine grain developer.

	Metric	*U. S. Units*
Water	900 cc	30 ounces
Metol (Elon, Pictol)	12 grams	180 grains
Fine Grain Sulphite	90 grams	3 ounces
Orthamine	12 grams	180 grains
Sodium Bisulphite	10 grams	150 grains
Water to make	1 liter	1 quart

This developer is softer working than Edwal-20. Edwal-20 will give more pleasing results on subjects where there are no violent contrasts and

for general photography in northern United States. Edwal-32 is better for subjects having strong contrast and for general outdoor work in the Southern States and tropical regions.

DEVELOPING TIMES IN MINUTES FOR EDWAL-32

Temperature	Class I	Class II	Class III	Class IV	Class V	Class VI	Class VII
65° F (18°C)	11	13	16	20	24	30	36
70° F. (21°C)	9	11	13	16	20	25	30
For 75° or above add one measure of Edwal Thermo-Salt per pint and develop:							
75° F. (24°C)	9	11	13	16	20	25	30
80° F. (27°C)	7	9	11	13	16	20	25
85° F. (30°C)	6	7	9	11	13	16	20

These times are for the *first* film. One quart will develop 15 rolls satisfactorily if protected from air. To determine the developing time for the second and subsequent rolls multiply the times given in the table by the following factors: 1.06 (for 2nd roll); 1.13 (for 3rd roll); 1.19; 1.25; 1.31; 1.38; 1.44; 1.5; 1.56; 1.62; 1.7; 1.8; 1.9; 2.

EDWAL MINICOL

Minicol is a prepared developer having properties somewhat similar to Edwal-32. Minicol, however, gives finer grain on the medium speed fine grain film than any developer we have ever tested. When used with films such as Finopan, Panatomic, Panatomic-X, Parpan, and Plus-X it is the ideal developer for the tourist and the vacationist who does not want to worry about fussy procedure but wants a good picture every time. It is also recommended for all strongly lighted close-up shots of flowers, insects, machinery, men's portraits, etc., wherever surface texture must be shown. Minicol is sold in prepared form only.

Since Minicol produces extremely fine grain and is designed to bring out texture and to render contrasty subjects (*e.g.,* photo flash pictures) without blocking up of highlights, it should also be used for brilliant summer sunlight shots (especially close ups and portraits). Exposure should be normal for miniature negatives, and 1½ to 2 times normal for larger negatives for contact printing. When extra contrast is needed, 20% extra development is suggested as it will not block highlights or seriously increase grain.

"Summertime" *Edmund W. Lowe*

Taken on Plus-X film developed in Minicol. Print developed in Edwal-111. Minicol is recommended for summertime photography where brilliant light is encountered.

EDWAL-36

A non-staining stock-solution-type fine grain developer.

	Metric	*U. S. Units*
Water	400 cc	**13 ounces**
Fine Grain Sulphite	50 grams	**1-2/3 ounces**
Edwal C. H. Q.	25 grams	**375 grains**
Edwal T. S. P.	9 grams	**135 grains**
Potassium Thiocyanate	5 grams	**75 grains**
Water to make	500 cc	**1 pint**

To Use: Dilute 1 part of stock solution with 9 parts of 10% sodium sulphite solution. Use for 1 or 2 rolls and then discard. A 10% sodium sulphite solution contains 3-1/3 ounces of Edwal Fine Grain Sulphite in 1 quart of water.

Edwal-36 produces negatives capable of enlargement to about 15 diameters on fast films, and somewhat more on the fine grain films.

The grain is slightly finer if 11 cc (3 drams) of commercial (90%) Triethanolamine is used in place of T. S. P.

DEVELOPING TIMES IN MINUTES FOR EDWAL-36

Temperature	Class I	Class II	Class III	Class IV	Class V	Class VI	Class VII
65° F. (18°C)	7	8	9	11	13	16	20
70° F. (21°C)	6	7	8	10	12	14	16
75° F. (24°C)	5	6	7	9	10	12	14

For development above 75° add one measure of Edwal Thermo-Salt per pint and develop:

Temperature	Class I	Class II	Class III	Class IV	Class V	Class VI	Class VII
75° F. (24°C)	6	7	8	10	12	14	16
80° F. (27°C)	5	6	7	9	10	12	14
85° F. (30°C)	4	5	6	8	9	10	12

These developing times are for soft negatives. For full contrast, the times given for Edwal-10 should be used for development in Edwal-36.

EDWAL THERMO-FINE

Thermo-Fine is a low priced fine grain developer designed for use by the beginner, the occasional photographer, and others who need fine grain similar to that produced by Edwal-12 but do not need the high emulsion speed produced by the latter developer. It is sold in tube form, is non-staining, and since it contains Thermo-Salt it can be used over a wide range of temperature. It requires no stop bath at normal temperatures since the chemicals in it will not harm any acid-fixer.

Thermo-Fine is a prepared powder developer, and complete directions for dissolving the powders are printed on the label of each tube. Distilled water is recommended, but any reasonably pure water can be used. The solution should always be cooled to 70° F. and allowed to stand a while (over night if possible) after completely dissolving the powders. Any solid matter present in the solution at that temperature should be filtered out and thrown away before the developer is used to develop film.

If the developer is cooled below 65°, crystals may form. If this occurs, the mixture should be warmed and stirred till the crystals redissolve. Occasionally crystals will form on long standing even though the developer is not cooled below 65° F. Such crystals may be filtered out and thrown away without harm to the developer.

How to Use Thermo-Fine:

When the film is placed in the developing tank, the Thermo-Fine solution is poured in, the temperature is measured, and the film is allowed to develop for the time specified in the tables below for that particular

Density in the print should be controlled almost entirely by exposure. If a print has been over-exposed, any attempt to keep the density down by shortening the developing time results in a muddy-looking picture with an off-color image. If a print is under-exposed, density can be allowed to build up to some extent by prolonged development, especially with the Edwal-102 or Edwal-106 developers. However, with too long a developing time, any developer (particularly those containing metol) will produce yellow stains and sometimes fog on the print.

The best way to control density is to determine the correct exposure by means of one of the exposure-meters made for the purpose, or by making "test strips" on which different parts of the same paper are given different exposures and then the correct exposure is determined by development of the strip.

Tone

The tone or color of the silver deposit in a print is very important. If the image is black with a slight bluish tinge, it is said to have a "cold" tone. If it has a brownish cast it is said to be warm-toned. Many papers tend to produce greenish or olive images, and these are also called warm tones, especially if there is some admixture of brown.

Each type of tone is good for some particular type of picture, though individual tastes differ quite widely on this point. Generally the neutral or "true-black" tones produced by Edwal-102 or Edwal-111 are most pleasing in the general run of pictures. Warm tones are often desired in portraits and landscape pictures and cold bluish-blacks are wanted in commercial photographs. Because of this the various Edwal paper developers are classified according to the tone they tend to produce. However, with any one developer, some papers will produce colder tones than others. It is also true that with any developer and any paper, a colder tone is produced by a long developing time and a warmer tone by a short developing time.

Print Quality

Aside from tone, density, and contrast, print quality is made up of a number of factors such as accuracy of gradation, sharpness of detail, type of paper surface, etc., over which the photographer has little control during development. The accuracy with which gradations and details are rendered depends partly on the paper used and partly on the constitution of the developer. Thus, the slow chlorobromide papers are better than the fast chlorobromides, and these in turn are better than the bromides for rendering delicate gradations and fine detail. Likewise, with any particular brand of paper, developers containing Monazol (Edwal-

102) or Amidol (Edwal-126) generally produce better gradations than those which do not.

Of course there are subjects where accurate recording of fine detail is not needed — in fact, not desired. Some subjects call for bold masses of tone, with detail only suggested or made unobtrusive. For such pictures, bromide papers and developers such as Edwal-120 are best. For the general run of pictures, Edwal-110 or Edwal-111 is recommended, especially with chlorobromide papers.

Classification of Papers

There are four general types of printing papers in common use. The bromides contain silver bromide as the light-sensitive agent and are used as fast enlarging papers. The fast chlorobromides require from two to four times as much exposure as the bromides, but are capable of recording fine detail more accurately. The slow chlorobromide papers require still longer exposure and are better than the fast chlorobromides for accurately rendering detail and delicate gradations. They can be used either for enlarging or for contact printing. As a group they tend to give warm tones. The fourth group, the chloride papers, are used exclusively for contact printing. With some brands, 4 or 5 grades of contrast are available.

Examples of the four classes are: *Bromide* (fast enlarging): Brovira, Charcoal Black, Coloma Kruxo, Gevaluxe Velours, Haloid Press Bromide, Haloid Record, Haynes Salon Special, Kodabromide, Marful Duplex, Novabrom, Portrait Proofing, Projection Proof, Record Kruxo, Stripping Kruxo, Translite Enlarging, Translux Kruxo, Transparex.

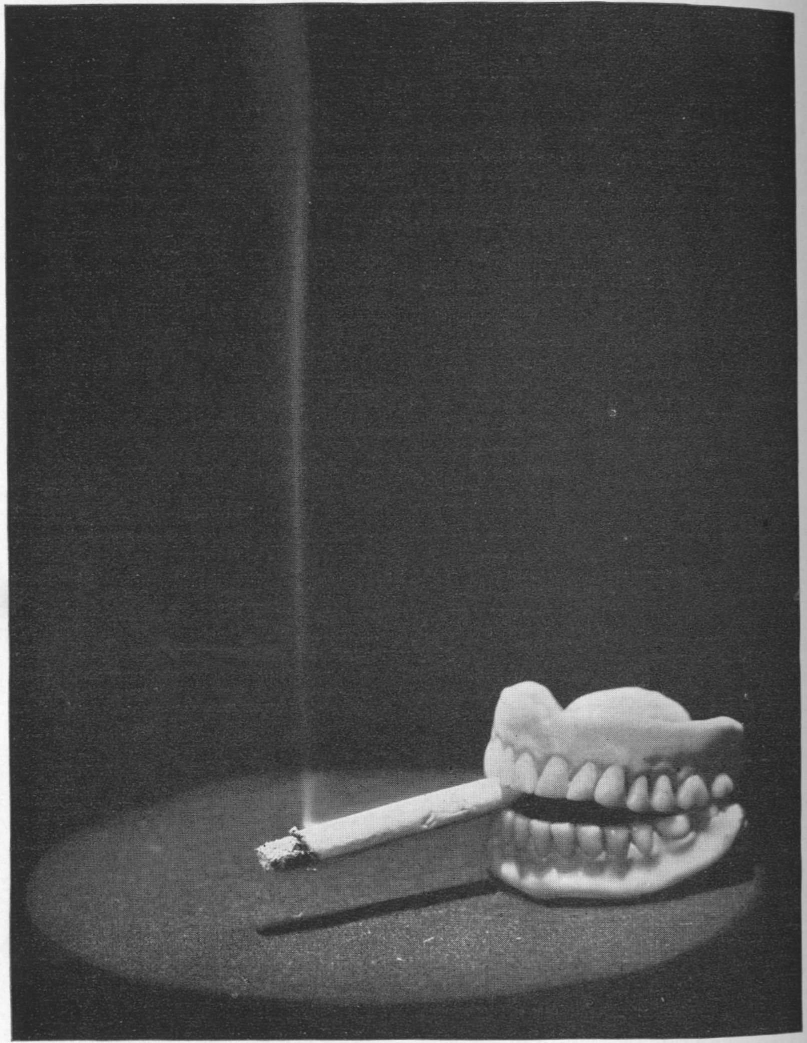
***Fast Chlorobromide* (enlarging): Agfa Portrait Enlarging Artex Projection, Artona Rapid, Cykora, Halobrome, Illustro, Novatone Rapid, Projecto, Varigam, Velour Black, Vitava Projection.**

***Slow Chlorobromide and Fast Chloride* (enlarging and contact): Copy House Enlarging Kruxo, Cykon, Illustrator's Special, Indiatone, Kodalure, Larjex, Marvel Brome, Portrait Enlarging Kruxo, Proof Kruxo, Veltura, Vitava Athena, Vitava Opal.**

***Chloride* (contact): Acme Kruxo, Ad-Type, Agfa Professional Papers (Cyko, Crystal Stipple, etc.) Apex, Artona Contact, Artura Iris, Azo, Commercial Kruxo, Convira, Halo, Industro, Letter Copy Kruxo, Marvel Contact, Novaflex, Novagas, Portrait Kruxo, Speedex, Velox, Wards Contact.**

Which Print Developer is Best?

There is no answer to the question, "which is best" unless one specifies "best for what?" Most people prefer a true neutral black image with neither a cold bluish nor a warm brownish tone. Hence for most amateur work, the Edwal-111 formula is recommended. If, however, the picture has many delicate gradations of tone (e.g. a blonde woman's portrait)



"Doctor's Out" *E. D. Nunn*

From a negative developed in Edwal-12.

Edwal-102 will be better. On the other hand, for subjects such as are encountered in stage photography where unnecessary detail is to be suppressed in the darkest portions of the print, Edwal-120 would be better.

For commercial work or for subjects which require a cold black tone, Edwal-126 or Edwal-110 would be suitable, the choice depending on whether very delicate gradations were needed or not. Or if brownish tones were preferred in an outdoor picture or portrait, Edwal-106 or 108 would be suitable. As some wise man said, "Tastes differ." Further recommendations are made in Chapter VII.

FORMULAS FOR TRUE-BLACK TONES

EDWAL-102—For delicate gradations.

	Metric	*U. S. Units*
Water	900 cc	30 ounces
Sulphite (Edwal)	80 grams	2-2/3 ounces
Edwal T. S. P.	120 grams	4 ounces
Monazol	25 grams	375 grains
Potassium Bromide	3 grams	45 grains
Water to make	1 liter	1 quart

(Available in prepared form)

To Use: Dilute with 3 parts of water for chloride and chlorobromide papers; with 4 parts of water for bromide papers.

A variation of the formula may be made by which an equal amount of Potassium Carbonate is substituted for the T. S. P. and 10 grams per liter (150 grains per quart) of Sodium Hydroxide (Caustic Soda) is added to make up for the lower alkalinity of the carbonate.

Edwal-102 is slower working than most print developers. The image usually appears in 1 to 1½ minutes and development is complete in 3 to 4 minutes. There is considerable latitude as to developing time, for pleasing tones can be obtained with any development from 2 to 6 minutes, thus allowing greater latitude in exposure time than with most formulas. The longer the developing time, the colder will be the tone.

Edwal-102 works best at 60 to 70° F. but can be used up to 90° F. if necessary. At higher temperatures the maximum developing time (without staining) is decreased from 6 minutes at 65° to 4 minutes at 85°. If possible, Edwal Thermo-Salt should be added to the developer when the temperature is 80° or above.

Prints developed in Edwal-102 should be rinsed for at least 2 minutes in a short-stop bath containing 1 ounce of citric acid per gallon of water to remove as much of the T. S. P. as possible before going into the fixing bath. Edwal Acid Fix should always be used with Edwal-102 or any other developer containing trisodium phosphate, because this Acid Fix has been so compounded as to prevent precipitation of insoluble aluminum phosphate in the fixer.

If aluminum phosphate is precipitated it may stick to the emulsion and spoil the luster of the finished print by leaving "hen-tracks" when it dries. If this should happen due to incorrect procedure, the precipitate may be removed by soaking the print in water, then briefly swabbing it with 5% hydrochloric acid and washing it for two or three minutes in running water.

Edwal-102 keeps well in the stock solution but will oxidize quite readily after it has been diluted. The diluted developer sometimes acquires a very dark color during use but this does not indicate exhaustion, as it will keep on developing prints long after it has acquired the color of motor-oil. The stock solution is very concentrated and will crystallize if stored at low temperatures. This may be remedied, if necessary, by diluting with an equal volume of water.

Edwal-102 for Lantern Slides and Negatives

Edwal-102 at the 1:3 dilution is an excellent developer for lantern slides. Its fog-producing tendency is so low that the necessity for treatment of the slides with ferricyanide to remove fog is eliminated and as a result much fine gradation and detail are saved.

Edwal-102 can be used to develop negatives if fine grain is not needed. For normal negatives, dilute with 3 parts of water and develop 4 to 6 minutes for common roll films. Higher dilutions may be employed for tank development. When diluted with 9 parts of water, develop 7 to 11 minutes, at 1:14 develop 10 to 14 minutes, and at 1:24 develop 15 to 19 minutes depending on the contrast desired.

EDWAL-111—For general print making.

	Metric	*U. S. Units*
Water	**900 cc**	**30 ounces**
Metol (Elon, Pictol)	**5 grams**	**75 grains**
Sulphite (Edwal)	**80 grams**	**2-2/3 ounces**
Monazol	**6 grams**	**90 grains**
C. H. Q.	**15 grams**	**225 grains**
Potassium Carbonate (Edwal)	**120 grams**	**4 ounces**
Potassium Bromide	**3 grams**	**45 grains**
Water to make	**1 liter**	**1 quart**

(Available in prepared form)

To Use: Dilute with seven parts of water for bromide papers, and five parts for fast chlorobromides (e.g. Vitava Projection). For slow chlorobromides (e.g. Opal, Indiatone, etc.) and contact papers, dilute with four parts of water.

Edwal-111 produces true black tones, with excellent contrast and detail. We believe it to be the best formula that has ever been devised for general amateur use.

The developing time for enlarging papers is 1½ to 3 minutes. The best black tones are obtained with a developing time of 2 minutes or over.

For tray development of negatives dilute with 8 parts of water and develop roll films 5 to 7 minutes. For tank development dilute with twenty parts of water and develop 15 to 18 minutes at 65° F.

EDWAL-120—For rich dense blacks.

		Metric	*U. S. Units*
A.	**Catechol (Edwal)**	**20 grams**	**300 grains**
	Sulphite (Edwal)	**40 grams**	**1-1/3 ounces**
	Water	**1 liter**	**1 quart**
B.	**Potassium Carbonate (Edwal)**	**120 grams**	**4 ounces**
	Water	**1 liter**	**1 quart**

For chloride and slow chlorobromide papers, mix one part A and two parts B and add ½ ounce 1% Orthazite stock solution per quart of developer. For fast chlorobromide, mix one part A, two parts B, and one part of water and add ½ ounce 1% Orthazite per quart. For bromide papers, mix one part A, two parts B, and two parts of water. Add 1 ounce 1% Orthazite per quart of dilute developer.

Edwal-120 produces very rich black tones and is useful for prints where bold masses of tone are desired (i.e. stage shots, etc.) and detail is to be suggested rather than rendered with great exactness. The developer can be made to give finer detail if desired by increasing the amount of Orthazite or by adding a little potassium bromide.

For tray development of negatives, mix one part of A, two parts of B, and one part of water. Develop 5 to 7 minutes.

FORMULAS FOR COLD BLUE-BLACK TONES

EDWAL-126—For delicate gradations.

	Metric	*U. S. Units*
Water	**900 cc**	**30 ounces**
Edwal Sulphite	**25 grams**	**375 grains**
Amidol (Edwal)	**6 grams**	**90 grains**
Potassium Bromide	**0.8 grams**	**12 grains**
Water to make	**1 liter**	**32 ounces**

This developer should be made up just before use, but can be kept for a few days in full tightly closed bottles, if necessary.

For development of chloride (contact) papers use Edwal-126 full strength and develop about 1 minute. For chlorobromides dilute with an equal volume of water and for bromide papers with 2 parts of water. Develop 1½ to 3 minutes. For softer pictures dilute with more water and for stronger contrast dilute with less water.

For tray development of negatives use Edwal-126 full strength and develop 3 to 7 minutes at 65° F. depending on the type of film used and the contrast desired. One pint will develop 2 dozen 3¼ x 4¼ negatives or an equivalent area of other film safely.

EDWAL-110—For general print making.

Stock Solution	*Metric*	*U. S. Units*
Water	**900 cc**	**30 ounces**
Metol (Elon, Pictol)	**2.5 grams**	**37 grains**
C. H. Q. (Edwal)	**7.5 grams**	**112 grains**
Sulphite (Edwal)	**30 grams**	**1 ounce**
Potassium Carbonate (Edwal)	**60 grams**	**2 ounces**
Orthazite	**2 grams**	**28 grains**
Water to make	**1 liter**	**1 quart**

To Use: Dilute with four parts of water for bromide papers, three parts of water for chlorobromides, and two parts of water for chlorides for cold bluish blacks, especially on papers. For stronger contrast, increase the amount of C. H. Q. up to 10 grams (150 grains). For less contrast, cut the C. H. Q. to 5 or 6 grams (75 to 90 grains).

FORMULAS FOR WARM TONES

EDWAL-106—The auto-toning developer.

	Metric	*U. S. Units*
Water	**900 cc**	**30 ozs.**
Sulphite (Edwal)	**85 grams**	**2¾ ozs.**
Sodium Carbonate (Anhyd.)	**145 grams**	**4½ ozs., 42 grains**
Monazol	**28 grams**	**¾ oz., 73 grains**
Hydroquinone	**9 grams**	**¼ oz., 24 grains**
Potassium Bromide	**4 grams**	**57 grains**
Water to make	**1 liter**	**32 ozs.**

With contact papers, Edwal-106 produces tones that vary from greenish brown to sepia and brick-red. With the slow chlorobromide papers it produces delicate tones that are very beautiful in high-key work, and with the fast chlorobromides it produces warm blacks and brown-blacks.

For bromide papers dilute with 3 parts of water for warm black tones. With Brovira, diluting Edwal-106 stock solution with 7 parts of water will produce brown tones. For chloride and chlorobromide papers, dilute with 7 parts of water and develop 4 to 6 minutes for brown-blacks. For brighter tones on chloride papers use 3 to 8 times the normal exposure and develop only until full detail is obtained (70 to 90 seconds). At a dilution of 15:1 Edwal-106 produces the so-called "gravure-brown" tones on enlarging papers and delicate green tones on Opal.

The tones obtainable with Edwal-106 on the chloride papers are worthy of detailed description. At 3 times normal exposure the following tones are obtained:

Artura Iris	Green
Apex	Red to red-brown
Azo	Brown to red-brown
Convira	Brown to red-brown
Cyko	Brown
Larjex	Red to brown
Novagas	Chocolate brown
Velox	Red-brown to brick-red
Vitava Athena	Sepia

As exposures are increased to 8 times normal the tones become brighter and tend toward brick-red. Increase beyond 8 normal does not produce any marked change. Developing times at 3 times normal exposure are 60 to 90 seconds and at 6 times normal exposure, 50 to 70 seconds. It is generally true that the tones appear somewhat brighter while the print is wet than after it has dried.

In determining the tone desired on contact paper a series of exposures 1, 2, 3, 4, 5, and 6 times normal, etc., should be made on separate strips and developed to the proper density. These should be fixed, washed and dried before finally judging the tone. Enlarging papers should not be given more than 1 to 1½ times normal exposure. Any contact paper will give pleasing tones with normal to 2 or 3 times normal exposure, but Artura Iris, Velox and Vitava Athena are especially good because of the richness and beauty of the tones which they give with the longer exposures from 3 to 6 times normal.

When a large number of prints are to be made from one negative, the exact exposure and developing time necessary to produce the desired tone should be determined and then each print should be exposed and developed according to these times. Otherwise, it is sometimes hard to match tones exactly if development by inspection is relied on.

A developer which is excellent for prints which are to be toned blue by a gold-chloride toner is

EDWAL-113

	Metric	*U. S. Units*
Water	**500 cc**	**16 oz.**
Sulphite (anhydrous)	**8.5 grams**	**128 grains**
Chlorhydroquinone	**1.1 grams**	**32 grains**
Sodium Carbonate (anhydrous)	**8.5 grams**	**128 grains**

Use without dilution. Development is carried on for about 1½ minutes and the print has a brownish tone on the slow chlorobromide papers for which it is recommended.

Color Separation Negatives and Positives

Because of the relatively long exposures that are required by the "one-shot" color cameras a developer must be used which does not sacrifice emulsion speed and at the same time produces fine grain. Edwal-12 is recommended and widely employed for this purpose. However, some workers prefer a softer working developer and have found that Edwal-12 with the Monazol reduced to 2 grams per liter serves their purpose very well.

For development of color separation positive (dye-tone process) the following Catechol formula has been found satisfactory:

EDWAL-121—For color positives.

	Metric	*U. S. Units*
Water	**400 cc**	**13 ounces**
Sulphite (Edwal)	**25 grams**	**375 grains**
Catechol (Edwal)	**10 grams**	**150 grains**
Sodium Carbonate (anhyd)	**50 grams**	**1-2/3 ounces**
Potassium Bromide	**2 grams**	**30 grains**
Water to make	**500 cc**	**1 pint**

Dilute the stock solution with 5 parts of water and develop 7 to 10 minutes. A 1:8 dilution may also be used and development carried on for 13 to 17 minutes.

Chapter VI

TECHNIQUE

A chapter on "How to do it"

•

EVERY photographer who mixes his own solutions from the pure chemicals, or who wants to do things out of the ordinary, encounters questions of procedure which he cannot answer unless he happens to be a chemist. It is the purpose of this chapter, therefore, to present a few of the "do's and don'ts" concerning ordinary chemical manipulations such as mixing and storing solutions, etc. The material included here is the result of several years of answering similar questions from amateurs all over the country.

Mixing and Storing Developers

It is usually specified that when the chemicals in a developer or fixer are being dissolved, they should be added in the order given in the formula. Each chemical should be completely dissolved before the next one is added. With most developers this is primarily a matter of convenience. Thus, Metol is usually dissolved before sulphite because Metol dissolves rapidly in plain water but only very slowly if the sulphite is dissolved first. In Monazol formulas the sulphite and the alkali (if any) are dissolved first because Monazol will not dissolve at all unless sulphite or an alkali is present.

Most developers are mixed in warm water (125° F.) and the sulphite is added as early as possible. This is because the sulphite removes the dissolved oxygen from the water, especially when the solution is warm, thus preventing oxidation of developing agents which are added later. If developers are to be stored for long periods their keeping qualities can be improved somewhat by adding part of the sulphite to the water and boiling for about 10 minutes before adding the remaining chemicals.

Developers should always be mixed in glass, enamelled, bakelite, or stainless steel vessels. Pewter, brass, or copper vessels, whether plated or not, should never be used. They contaminate the developer causing fog and, in the case of fine grain developers, coarse grain and excessive contrast. Developers should never be mixed in aluminum, because the alkalies attack the metal.

A developer will gradually oxidize if stored in a partly filled bottle, thus losing its strength. It has been suggested that bottles of developer of a dye to the silver image may also be used to intensify the negatives. Blue or green dye toners are the best since they increase the density of the image to the photographic portion of the enlarging or printing light. The dilutions recommended for print toning may be used for this purpose but Edwal Thermo-Salt should be added to the bath to prevent reticulation. After toning the films should be washed to remove excess dye from the shadow areas of the negative where there is little silver. With very thin negatives the dye may be left even in the shadow areas to increase the over-all printing time for the negative to allow more control. If desired, the toning method of intensification may be used after the chromium intensifier to increase the total intensification.

Reduction of Dense Negatives

If a negative is too dense to give a good enlargement with a reasonable printing time it can usually be improved by treatment with one of the common reducing solutions. The type of reducer which should be used depends on the kind of negative that is to be reduced. If the negative is too dense because of over-exposure it is usually rather flat and a so-called "subtractive" reducer such as the ferricyanide-hypo bath, commonly called Farmer's Reducer, is best because it attacks the weaker parts of the image more than the denser portions, thus increasing contrast.

For negatives which have been badly over-developed and hence are very contrasty, a "super-proportional" reducer, generally containing ammonium persulphate is used because it tends to reduce contrast or "flatten" the image. Reduction does not usually cause an appreciable increase in graininess. On the other hand, while it may make individual grains smaller, it will not undo clumping that has taken place during development, and will not therefore make a fine or even-grained negative out of a "coarse-grained" negative.

The reducers given here do not comprise all the known formulas but are considered to be best suited to amateur or occasional professional use because they are easy to prepare and are not violently poisonous. Before reducing, negatives which have been developed in an alkaline developer should be hardened in the formaldehyde-carbonate bath described in the section on intensification. One negative should be handled at a time and it should be agitated frequently during treatment. All negatives should be thoroughly fixed and, except with the ferricyanide-hypo solutions, must be washed completely free of hypo before being placed in the reducer.

Following reduction, the negative should be washed thoroughly before drying.

FARMER'S REDUCER (subtractive type)

	Metric	*U. S. Units*
Solution A		
Water	30 cc	1 ounce
Potassium Ferricyanide	1 gram	15 grains
Solution B		
Water	1 liter	32 ounces
Hypo	30 grams	1 ounce

To use, add solution A to solution B and immediately pour over the negative to be reduced. The reducer deteriorates rapidly after the two solutions are mixed. The negative should be watched during reduction and when it has reached the desired density it should be immediately placed in running water and washed thoroughly before drying. The formula as given is fairly slow working, and allows a reasonable degree of control. If faster action is desired the amounts of ferricyanide and hypo may be proportionately increased.

The two solutions may be made up in more concentrated form if desired and used as stock solutions. However, the ferricyanide should be stored in a dark place since it is gradually decomposed by light. Farmer's Reducer applied with a cotton swab is useful in locally lightening small areas in prints. Also, negatives or prints which are slightly fogged may be improved by a brief immersion in Farmer's Reducer which has been diluted with 2 or 3 parts of water.

TWO SOLUTION FARMER'S REDUCER

This formula gives almost proportional reduction and can be used where it is desired to decrease general density without either increasing or decreasing contrast.

	Metric	*U. S. Units*
Solution A		
Water	1 liter	1 quart
Potassium Ferricyanide	7.5 grams	¼ ounce
Solution B		
Water	1 liter	1 quart
Hypo	210 grams	7 ounces

Harden the film (if developed in an alkaline developer) in the formalin-carbonate bath as described in the section on intensification. Immerse the negatives in solution A for 1 to 4 minutes with agitation. Then immerse in B for 5 minutes and wash thoroughly in running water. If reflects so much light that photographically there are no deep shadows and the picture is to all intents and purposes flat. Of course, filters can be used to cut the effects of the haze and help record on the film the desired contrast—but that is another matter.

Once the photographer knows the kind of picture he wants to make and the type of subject he has to make it from, he can pick out the best developing technique to use.

How Developers are Classified

There are, of course, fine grain developers, and the opposite; developers that give good gradations, and the opposite; fast-working developers, and the opposite—but the classification which is of most interest at this time is on the basis of contrast. There are the high-contrast developers (e.g. hydroquinone-caustic soda) which give little or no shadow detail and terrific highlight density and are used for copying line drawings or printed matter. No formulas strictly of this type are given in this book, though Edwal-12 can be made to give very strong contrast, if desired by increasing the Monazol content to 8 or 10 grams per liter as described in Chapter III.

Then there are the average-contrast developers which give a long tone scale, with detail and gradually increasing density from one end of the scale to the other. On flat subjects or with soft lightings, these developers can be made to "pep-up" the contrast when necessary by increasing the time of development. With average (not too bright) lighting these developers produce full-scale negatives which print well, especially on the chlorobromide papers. In the northern United States the outdoor light is usually of this "average" variety (except in mid-summer) and hence most of the developers used then are of the "average-contrast" or full scale type. Edwal-10, Edwal-12, and Edwal-20 are examples, though Edwal-20 is somewhat softer working than the other two, especially after it has been used for 2 or 3 rolls per quart.

With very brilliant light, or on contrasty subjects the "average-contrast" developers produce so long a tone scale on the negative that the printing paper cannot record it. As a result there is blocking-up in the darker areas or loss of detail in the lighter areas or both. This can be cured by under-developing the film so as to shorten the tone scale on the negative. This, however, compresses the tone scale throughout its entire length so that the middle tones tend to "run-together" so to speak. Also, under-development causes some loss of emulsion speed. These disadvantages can be avoided by the use of one of the third class of developers, the "soft-working" type.

A "soft-working" developer produces a shorter tone scale than the "average-contrast" variety, not by compressing the tone scale throughout its entire length, but by shortening the steps at the upper end. For those who enjoy curves and graphs, this is most easily shown by superimposing the H. & D. characteristic curves produced by an average contrast developer (A) and a soft working developer (B) on the same film. It will be seen that, with the "soft-working" developer, in the brightest areas (where exposure is great) a given increase in exposure produces a smaller difference in density than with the "average-contrast" developer, though in the middle tones the two solutions act very much alike. Thus detail throughout the entire range is retained because the tone scale of the negative never gets so long that a printing paper cannot record it.

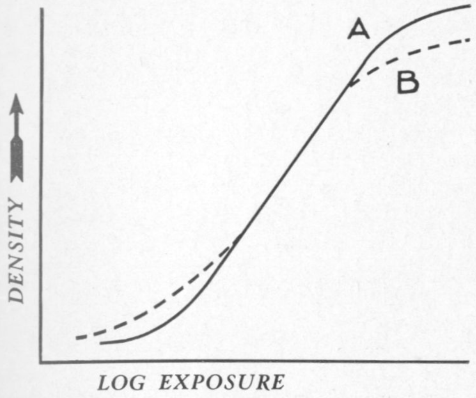


Fig. 13—Characteristic "H. & D." curves obtained by developing a film in (A) a full-scale developer such as Edwal-12 and (B) a soft-working developer such as Minicol.

Minicol, and to a lesser extent, Edwal-32, and Edwal-12 with the Monazol cut to 2 grams per liter are "soft-working" developers. These developers should be used in photographing contrasty subjects in brilliant light such as outdoor portraits in summer sunlight or most outdoor photography in southern United States and tropical countries. They are especially effective in photography of small near-by objects such as flowers, insects, rocks, and the like because over-development can be resorted to for emphasis of texture without losing detail through blocking up of the highlight areas. Of the developers mentioned, Minicol will give the finest grain, especially on the medium speed films. Edwal-32 runs a close second.

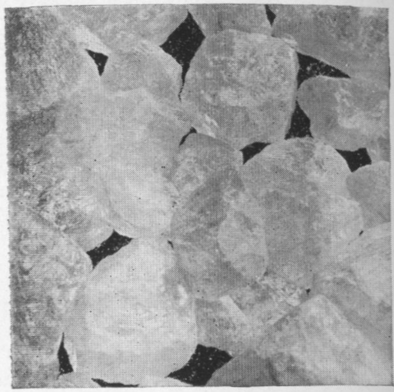
Specific Suggestions

It will be gathered from the foregoing discussion that generally speaking it is best to use an "average-contrast" developer with a soft or average-lighted subject, and a soft-working developer with a brilliant lighting. There are of course exceptions. Often, in stage photography for instance (where lighting is very contrasty) it is necessary to use a

EDWAL PHOTO PRODUCTS

Edwal Pure Chemicals

The units in which Edwal pure photo-chemicals are commonly marketed are listed here, together with prices. Prices on larger quantities may be had on request. All the developing agents are packed in amber, screw cap bottles. The alkalis and Fine Grain Sulphite are packed in cans. The formulas given in this book are specifically designed for Edwal chemicals. The use of other brands of chemicals may produce results entirely different from those specified here.



These are crystals of purified Diamine-P before being ground and packed in bottles. Diamine-P is the purest paraphenylenediamine that can be made

IF YOU MIX YOUR OWN SOLUTIONS

Insure dependable results by using the same pure chemicals from which Edwal Prepared Developers are compounded. They may be purchased from your photographic dealer.

EDWAL PHOTO-PURE CHEMICALS

AMIDOL (diaminophenol dihydrochloride) 1 oz. 65c; 4 oz. $2.20; 1 lb. $7.20
CATECHOL (pyrocatechin, C. P.) 1 oz. 60c; 4 oz. $1.80; 1 lb. $6.20
C. H. Q. (chlorohydroquinone) 1 oz. 65c; 4 oz. $2.20; 1 lb. $7.20
DIAMINE-P (pure paraphenylenediamine) 1 oz. 50c; 4 oz. $1.35; ½ lb. $2.50; 1 lb. $4.50
GRADOL 1 oz. 50c; 4 oz. $1.50; ½ lb. $2.50; 1 lb. $4.50
MONAZOL (photographic glycin) 1 oz. 60c; 4 oz. $1.80; ½ lb. $3.20; 1 lb. $6.20
ORTHAMINE (Orthophenylenediamine) 1 oz. 65c; 4 oz. $2.20; 1 lb. $7.20
POTASSIUM CARBONATE (anhydrous) 1 lb. 40c; 5 lb. $1.50
FINE GRAIN SULPHITE (pH controlled for fine grain work) 1 lb. 28c; 5 lb. $1.25
EDWAL T. S. P. (Trisodium Phosphate monohydrate) 1 lb. 45c; 4 lb. $1.25
THIAMATE (non-hypo high-speed fixing agent) 6 oz. 50c; 1½ lb. $1.10

EDWAL PREPARED DEVELOPERS

For those who wish to buy their developers ready-mixed the most popular of the Edwal formulas are marketed in prepared form.

FINE GRAIN FILM DEVELOPERS

Edwal-12 (powder)	1 Qt. $0.85;	
Super-12 (liquid)	1 Qt. 1.35;	1 Gal. $3.95
Edwal-20 (powder)	1 Qt. .85;	
Super-20 (liquid)	1 Qt. 1.35;	1 Gal. 3.95
Edwal-20 High Energy Replenisher (powder)	1 Qt. .85;	
Minicol (powder)	1 Qt. .95;	
Minicol (liquid)	1 Qt. 1.35;	1 Gal. 3.95
Thermo-Fine Tube Developer (powder)	1 Qt. .35;	
Micrograin-85 (powder)	1 Qt. .85;	
Micrograin-85 (liquid)	1 Qt. 1.35;	

PRINT DEVELOPERS

Edwal-102 (liquid)	
Pint makes 5 pints of working solution	Pint $0.85
Quart makes 5 quarts of working solution	Quart 1.35
Edwal-111 (liquid)	
Pint makes 5-8 pints of working solution	Pint $0.85
Quart makes 5-8 quarts of working solution	Quart 1.35
Gallon makes 5-8 gallons of working solution	Gallon 3.95

KODAK Sepia Toner

KODAK Sepia Toner is a two-solution toner of the bleach and redevelop type. It is one of the few toners that will produce a pleasing warm-brown tone on cold-tone papers. With inherently warm-tone papers, it tends to produce rather pronounced yellowish brown tones. Varying the tone color by varying toning time is not possible with sepia toner; to avoid irregular tones, prints must be fully bleached before sulfiding. A slight brownish image of the darkest print tones, with all lighter tones having become invisible, indicates the bleaching is complete.

Package Size. Available in a 2-part packet to make 1 quart (946 millilitres) each of bleach and toner.

Chemical Processing Aids

KODAK Anti-Fog, No. 1

(Benzotriazole)

KODAK Anti-Fog, No. 1, tends to suppress fog when added to a film or paper developer, and thus effectively increases contrast by producing relatively fog-free negatives and clean highlights in the prints. Anti-Fog, No. 1, is useful when films or papers tend to show fog from excessive age or unfavorable storage conditions, when long storage of films or papers has occurred between exposure and processing, and when forced development seems necessary. It is also useful in retarding fog during warm-weather processing, when it may not be possible to maintain the developer at 20°C (68°F).

Package Size. Available in 50-tablet bottles and 1-pound (454-gram) bottles of dry powder.

KODAK Anti-Fog, No. 2

(6-Nitrobenzimidazole Nitrate)

KODAK Anti-Fog, No. 2, tends to suppress certain types of fog when added to a film prehardener or film developer. Anti-Fog, No. 2, is useful against fog caused by aldehydes in prehardeners and developers, and is also effective against fog caused by aeration of developers. It is not interchangeable with KODAK Anti-Fog, No. 1.

Package Sizes. Available in 5-pound (2.27-kilogram) bottles of dry powder.

KODAK Defoamer

KODAK Defoamer is an inhibitor particularly recommended for the prevention of air bells, spots, streaks, or stains caused by foam or froth on photographic processing solutions. It can be used in any photographic solution.

KODAK Defoamer is effective in very small quantities and should be used sparingly. Using a cotton swab, paint a thin line of Defoamer on the tank walls about 1 inch or so above the solution level. When foam is produced and touches the line, the foam is broken up without introducing much Defoamer into the bulk of the solution.

Package Size. Available in 8-fluidounce (236-millilitre) bottles.

KODAK PHOTO-FLO Solution

KODAK PHOTO-FLO Solution is a powerful wetting agent that has been carefully selected as safe and dependable for photographic use. PHOTO-FLO Solution decreases the surface tension of water so that it flows evenly from the surface of the film without collecting in drops.

SOLUTION	KEEPING PROPERTIES WITHOUT USE				USEFUL CAPACITIES	
	Stock Solution In Stoppered Bottle		Working Solution		8 x 10-Inch Sheets Per Litre (Gallon)	
KODAK Film and Plate Developers	**Full**	**Half Full**	**Tray**	**Gallon Tank**	**Tray**	**Narrow and Deep Tank**
D-8	2 mo	2 wk	2 hr (2:1)	48 hr (2:1)	16 (60) (2:1)	16 (60) (2:1)
D-11	6 mo	1 mo	24 hr	1 mo	8 (30)	10 (40)
D-19	6 mo	2 mo	24 hr	1 mo	12 (45)	16 (60)*
DK-20	6 mo	2 mo	24 hr	1 mo	4 (16)	4 (16)
D-23	6 mo	2 mo	24 hr	1 mo	4 (16)	4 (16)
D-25	6 mo	2 mo	24 hr	1 mo	4 (16)	4 (16)
DK-50	6 mo	2 mo	24 hr	1 mo	5 (20)	10 (40)*
DK-50 (1:1)	6 mo	2 mo	12 hr	2 wk	2 (10)	5 (20)
DK-60a	6 mo	2 mo	24 hr	1½ mo	5 (20)	10 (40)*
D-61a	6 mo	2 mo	24 hr (1:1)	2 wk (1:3)	4 (15) (1:1)	8 (30) (1:3)
D-76	6 mo	2 mo	24 hr	1 mo	4 (16)	4 (16)*§
MICRODOL-X‡	6 mo	2 mo	24 hr	1 mo	4 (16)	4 (16)*§
HC-110 (Concentrate)‖	—	—	—	—	—	—
HC-110 (Dilution A)	6 mo	2 mo	24 hr	1 mo	5 (20)	10 (40)*
HC-110 (Dilution B)	6 mo	2 mo	12 hr	2 wk	2½ (10)	5 (20)*
TECHNIDOL Liquid	indef	—	—	1 wk in full stoppered bottle	—	2/135-36 rolls 1/120 roll
TECHNIDOL Powder	—	—	—	24 hr in dev. tank	—	2/135-36 rolls
VERSATOL (Concentrate)‖	—	—	—	—	—	—
VERSATOL (1:7)	6 mo	2 mo	—	2 wk	—	4 (15)
HRP	6 mo	2 mo	8 hr	2 wk	16 (60)	16 (60)
DURAFIN	6 mo	2 mo	—	1 mo	—	—
KODAK Paper Developers						
D-52	3 mo	1 mo	¶	—	21 (80) (1:1)	—
D-72	6 mo	2 mo	¶	—	26 (100) (1:2)	—
SELECTOL	4 mo	6 wk	¶	—	21 (80) (1:1)	—
SELECTOL-SOFT	4 mo	6 wk	¶	—	21 (80) (1:1)	—
DEKTOL	6 mo	2 mo	¶	—	32 (120) (1:2)	—
EKTAFLO, Type 1 (Concentrate)‖	—	—	—	—	—	—
EKTAFLO, Type 1 (1:9)	—	—	8 hr	—	26 (100)	—
EKTAFLO, Type 2 (Concentrate)‖	—	—	—	—	—	—
EKTAFLO, Type 2 (1:9)	—	—	8 hr	—	26 (100)	—
EKTONOL	4 mo	6 wk	¶	—	21 (80)	—
VERSATOL (Concentrate)‖	—	—	—	—	—	—
VERSATOL (1:3)	6 mo	2 mo	¶	—	21 (80)	—

*Life of developer can be extended by proper replenishment.

‡Data also apply for KODAK MICRODOL-X Liquid Developer.

§When developing time is increased by approximately 15 percent after each sheet per litre (four sheets per gallon).

‖Keeps indefinitely in the original sealed package.

¶One working day.

NOTE: DURAFLO RT Developer/Replenisher for photofinishing equipment lasts 4 weeks in a storage tank with a floating cover. Working solutions last 3 weeks at room temperature in a processor turned "off," 4 days in a processor turned "on," and indefinitely in a processor doing a normal film load 6-8 hr/day.

ROLL SIZE	NO. OF ROLLS	EQUIVALENT NO. OF 8 x 10-INCH SHEETS
127	2	1
135 (36 exp)	1	1
120 or 620	1	1
116 or 616	1	1½
126 (12 exp)	7	2
110 (12 exp)	9	1
150 ft x 35 mm	—	30

Removing Fixer with Washing Aids

Various washing aids will speed up the rate at which the fixer is removed from the paper and, thus, reduce the washing time for prints. KODAK Hypo Clearing Agent, a very effective washing aid, is used to facilitate faster fixer removal than is usually possible with water at an equivalent time. When Hypo Clearing Agent is used with fiber-base papers, a 10-minute wash for single-weight prints, or a 20-minute wash for double-weight prints, is adequate, even with water as cold as 2°C (35°F). Used at 18.5 to 24°C (65 to 75°F), for the times just given, Hypo Clearing Agent removes fixer faster than does only a water wash.

Drying Prints

After thoroughly washing the prints, place them on a clean glass or other nonporous surface and remove the excess water from their surfaces. Do this with a squeegee, or a photographic grade sponge. Resin-coated prints should be squeegeed on the back side only.

Dry matte or glossy RC prints, which do not require ferrotyping, with a hair dryer, in a KODAK Photo Blotter Roll, between sheets of KODAK Blotting Paper, on a muslin, Fiberglas or plastic-screen drying rack, on a twin-belt, matte drying machine, or by hanging them by the corners from a clothesline. Do not use a double-belt dryer for resin-coated papers.

Glossy fiber-base papers can be ferrotyped on chromium-plated sheets or on a ferrotyping drying machine. Prints ferrotyped on plated sheets should be allowed to dry naturally. Those ferrotyped on heated-drum machines are best dried at a temperature of approximately 82°C (180°F).

F-surface, resin-coated papers, such as KODAK POLYCONTRAST Rapid II RC Paper F, must not be ferrotyped. They dry to a glossy surface without ferrotyping.

Cleanliness is most important to all ferrotyping operations. The wash water should be filtered to remove all solid particles. And the glazing surface of plates and machines, as well as the conveyor belts of machines, should be

TONING

The silver image in prints produced by development is normally neutral or brownish neutral. With some papers, it can be modified in a very limited way by changes in the developer to produce more pronounced tones. The silver image also can be changed by chemical means. The process of chemically changing the color of the image is called toning. In most of the popular toning treatments, the silver image particles are converted to other metallic or inorganic compounds. Sulfur toners change the silver to silver sulfide, for example, while gold toners "plate" the silver particles with gold.

Preparation for Toning

The color of a toned print is influenced by many factors, including the paper type, grade, surface, and stock tint, as well as processing variations. The visual contrast and densities are often changed, too. To attain the best possible quality, all of these factors should be considered and, if necessary, adjusted prior to toning.

A full scale of tone values, with sufficient detail in the highlights and shadows, is necessary in prints to be toned. Prints to be toned in KODAK Sepia Toner should receive an increase in exposure, the amount depending on the kind and grade of paper because this toner tends to reduce the print densities. Prints to be toned in KODAK Brown Toner should be given a very slight increase in developing time, the amount again depending on the kind and grade of paper. A slight increase in print development is needed with KODAK POLY-TONER diluted 1 to 50. KODAK Rapid Selenium Toner intensifies the image a little, and prints may be improved by slightly less development. However, an increased tonal scale can be achieved by selenium toning a fully developed print.

To avoid stains with prints which have been reduced, you must fix and wash them well before toning. Residual silver salts and fixer retained in the paper may cause uneven toning or staining. For thorough washing, the prints should be rinsed in water after they have been fixed, and then treated in KODAK Hypo Clearing Agent

TONING CLASSIFICATION CHART

Papers	Developer or Process
POLYFIBER™	DEKTOL
AZO F-2*	DEKTOL
POLYPRINT RC	DEKTOL
EKTALURE	SELECTOL
KODABROMIDE F2*	DEKTOL
ELITE	DEKTOL
VELOX F-2*	DEKTOL
VELOX UNICONTRAST F	DEKTOL
POLYCONTRAST Rapid II RC F	DEKTOL RPP
KODABROME II RC 2	DEKTOL RPP
PANALURE F	DEKTOL
PANALURE II RC	DEKTOL RPP
EKTAMATIC	DEKTOL 214
Mural	SELECTOL
PREMIER II RC	DEKTOL RPP

N	No Tone Change
VS	Very Slight Tone Change
S	Slight Tone Change
M	Moderate Tone Change
F	Full Tone Change
RPP	Processed in the KODAK ROYALPRINT Process
214	Processed in the KODAK EKTAMATIC Processo

*Other contrast may produce slightly different tone cha

Paper Characteristics

Not all papers tone alike. To a
many negative ranges and to s
tastes of photographers and th
applications to which photogra
put, a variety of paper emulsio
These necessary variations in
and image tone affect the tonin
color. The following chart give
classifications for different pap
combinations. Since the toners
in both color and strength, som

Tray Development: Several Sheets of Film

The following method of developing 2 to 6 sheets of film in a tray is capable of producing good negative uniformity. However, take considerable care to prevent scratches or finger marks. Also, the temperature of the developer should not exceed the recommended range, and the use of highly alkaline developers such as D-8, D-11, and D-19 should be avoided to prevent softening of the gelatin. A modification of this procedure is recommended for tray development of color-separation negatives.

Using trays slightly (next size) larger than the film sheets and with the solutions at the proper temperature, follow these steps:

1. Immerse the exposed sheets one at a time and emulsion side up in a tray of water, at not above 24°C (75°F). The topmost sheet must be completely covered with water before the next one is placed over it. When all the sheets are in the tray, draw one carefully from the bottom and place it on top. Handle the film only by the extreme edges, and take care to prevent a corner of it from digging into the emulsion of the sheet on the top of the pile. Repeat this replacement from bottom to top until all sheets have been leafed through twice. This prewetting procedure will prevent sheets from sticking together and also dislodge any air bubbles which may have formed.
2. Start the timer and transfer the sheets quickly, one at a time, from the bottom of the pile into the developer tray. Briefly drain each sheet before transferring it. Continue the rotation of film sheets from bottom to top throughout the period of development. At intervals, turn the sheets 90°, emulsion side up, as you place them on the top of the pile.
3. When development is complete, transfer the sheets, one at a time, to the stop bath and leaf through the pile twice. Contamination of the developer with the stop bath can be avoided by using one hand for removing the films from the developer and the other hand for immersing them in the stop bath.
4. Place the sheets, one at a time, in the fixing bath. Continue the replacement from bottom to top 2 or 3 times continuously—then at intervals until the negatives are completely fixed.
5. Wash the negatives in running water for 20 or 30 minutes by continuing the rotational method or by placing the negatives in developing hangers and using a washing tank.

DRYING FILMS

After washing, grit and scum should be swabbed under water from the emulsion with a tuft of cotton applied. As soon as the film is taken from the wash water for drying, water droplets should be removed with a damp KODAK Photo Chamois or soft viscose sponge. Or you can bathe the negatives in diluted KODAK PHOTO-FLO Solution for about 30 seconds and then let them drain. The negatives preferably should be removed from the channel-type hanger before drying.

Dry the negatives in a warm, dry room free from dust and excessive drafts, or in a cabinet supplied with warm, filtered air.

DEVELOPING TIMES

Developing recommendations for various Kodak films are given in the instructions packaged with the materials. The developing times suggested will usually produce a degree of development suitable for the types of work for which each material is most often used. Longer or shorter times can be used if experience indicates that an increase or decrease in the degree of development would be desirable for the particular working conditions and the type of camera and printing equipment in use.

The times given in connection with each developer formula, and on the labels of packaged developers, are average times that give good results with most materials. Naturally, they cannot agree exactly with the different times which are recommended specifically for each individual material.

The recommended development temperature for most films is 20°C (68°F), but many films can now be satisfactorily developed at higher and lower temperatures. Instructions packaged with most Kodak films give development times for various appropriate developers at temperatures ranging from 18.5 to 24°C (65 to 75°F). For development at temperatures above 24°C (75°F), follow the method outlined under **High-Temperature Processing,** page 34.

The developing dial in the *KODAK Complete Darkroom DATAGUIDE,* R-18, provides a convenient means for determining the development times needed to produce approximately equal degrees of development with a large number of combinations of Kodak films and developers. It also provides a very convenient means for adjusting the times if a higher or lower degree of development is desired.

cannot be inverted without spilling the developer, slide it around in circles on the counter for the same length of time. For agitation of KODAK Technical Pan Film in KODAK TECHNIDOL LC and Liquid Developers, see pages 42-43.

3. Pour out the developer and fill the tank with KODAK Indicator Stop Bath or KODAK Stop Bath SB-5, at 18.5 to 24°C (65 to 75°F). Agitate continuously for about 30 seconds. For a water rinse, empty and refill the tank several times with fresh water of approximately the same temperature.
4. Pour the fixing bath into the tank and agitate the tank as above for about 30 seconds. Repeat several times during fixing.
5. When fixing is complete, wash the negatives for 30 minutes in running water. This can be done in the uncovered tank. Empty the tank at 5-minute intervals to obtain more thorough washing.

Tank Development: Sheet Films in Hangers

Do not develop more films in a tank than can be accommodated with at least a 1-centimetre (1/2-inch) separation between each sheet. A 3 1/2-gallon KODAK Hard Rubber Tank accommodates twelve 8 x 10-inch KODAK Film and Plate Developing Hangers No. 4A. For ease in handling batches of hangers, use the KODAK Developing Hanger Rack No. 40. This rack takes twelve 8 x 10-inch film hangers and fits into the 3 1/2-gallon hard rubber tanks. As a safeguard against the films touching one another during processing, and to maintain even separation between the films, use KODAK Hanger Separators (for KODAK Developing Hanger Rack No. 40), supplied in a set of two.

Arrange the tanks so that the plane of the films will be parallel to the front edge of the bench or sink. With the processing solutions at the recommended temperature, turn out the light, load and assemble the developing hangers, and proceed as follows:

1. Start the timer. Lower the hangers as a unit smoothly and carefully into the developer. Immediately tap the hangers sharply 2 or 3 times on the upper edge of the tank to dislodge any air bubbles clinging to the emulsion. Check the spacing of the hangers to make certain that they are at least 1 centimetre (1/2-inch) apart.
2. Then lift, tilt, and drain the hangers 2 times each minute. Tilt the hangers to the right one time, then to the left the next to get even development. Reimmerse the hangers quickly into the solution after each cycle and check their spacing. The entire cycle of lifting and reimmersion should be as rapid as possible without interfering with smooth operation. It should be completed in about 5 to 7 seconds. *Caution:* With films larger than 5 x 7 inches (12.7 x 17.8 centimetres), take care not to lift or immerse them so quickly that the films are pulled from the hangers.
3. When development is complete, lift the hangers from the developer, drain them for 2 or 3 seconds, and transfer them to the stop bath or rinse water. Lift and reimmerse the hangers several times before transferring them to the fixing bath.
4. Lift and reimmerse the hangers several times at the beginning of fixing and again at the end of the first minute. Allow them to remain until fixing is complete. Separation of the hangers and frequent agitation will shorten fixing time.

Tray Development: Single Sheet of Film

Tray development of a single sheet of film can be accomplished best by placing about 1 centimetre (1/2 inch) of developer in a tray somewhat larger than the film. With the solutions at the proper temperature, proceed as follows:

1. Start the timer and immediately slide the film, emulsion side up, smoothly into the developer. Agitate the tray continuously throughout development as follows:

   Raise the left side of the tray about 1 to 2 centimetres (1/2 to 3/4 inch), lower it smoothly, and then immediately raise and lower the near side similarly. Next, raise and lower the right side, and then again the near side. These four operations constitute an *agitation cycle,* which requires a total time of about 8 seconds.
2. When development is complete, rinse the negative in a separate tray with agitation for several seconds in fresh water or a stop bath.
3. Transfer the film to the fixing bath and agitate by rocking the tray as described above for about 30 seconds. Repeat the agitation at intervals for the duration of the fixing time.
4. Wash the negative in running water for 20 to 30 minutes.

Processing Techniques

The following section is devoted to manual processing of films and papers. If large quantities of films or papers must be processed daily, or if negatives must be processed in a minimum of time, investigate the possibilities of mechanized processing.

PROCESSING FILMS

Tank development with intermittent agitation is recommended for both roll and sheet films. A tank lets you produce clean, evenly developed negatives, and at the same time permits accurate control of development factors. Tank development is the most practical method of processing 35 mm films.

In the development of films, certain methods of agitation must be followed to develop the film uniformly and keep it free from developer flow marks. Development irregularities due to improper agitation are a principal cause of many poor-quality negatives. Such effects as edge intensification, streaks, irregular densities, and mottle are caused by insufficient or excessive agitation, but can be avoided by following the various recommended procedures.

When films receive little or no agitation, or are allowed to remain undisturbed for long periods without agitation, the accumulation of development by-products adjacent to the film is not replaced adequately by fresh developer solution, and uneven development results. With excessive agitation, intensified edge development may occur because of the greater turbulence of developer around the edges of the film, or through the perforations of developing hangers.

Where volume of work warrants its installation, the gaseous burst method of agitation provides the most nearly ideal method for practical photographic service. It is reasonably economical and, because it is automatic, does not require full-time attention. This method is not, however, recommended for use with films in spiral reels. More detailed information can be found in KODAK Publication No. E-57, *Gaseous-Burst Agitation in Processing.* Single copies are available on request from Department 412-L, Eastman Kodak Company, 343 State Street, Rochester, New York 14650.

The several procedures described in the following pages will produce uniform, high-quality results. These instructions assume correct use of the recommended safelight.

Unloading Film Magazines and Cartridges

Carry out the following procedures in total darkness.

Size 135 Magazines

Using a bottle-cap opener, lift the metal cap from either end of the magazine (the end where the spool does not project is generally the easier one to open). Draw the loaded spool out, taking care not to let the film unwind itself. Feed the film into any standard 35 mm processing reel.

Size 126 Cartridges

Using both hands, grasp the two cylindrical chambers of the exposed 126 cartridge. Break the cartridge in half by bending the chambers toward the label. Remove the film spool from the large chamber by separating the plastic sections surrounding the spool. Unroll the film and the paper backing.

Size 110 Cartridges

Using both hands, grasp the 2 cylindrical chambers of the exposed 110 cartridge. Hold the cartridge with the label facing you and your thumbs on the label. Break the cartridge by bending the chambers back. Next, pull the film and its paper backing from the take-up chamber. (Pull so that the *paper* rubs against the inner surface of the cartridge back. This precaution minimizes the likelihood of scratching the emulsion.) If the film trailer has been wound into the take-up chamber, you will have to pry open the chamber (after breaking the cartridge) to retrieve it.

Small-Tank Development: Roll Films, Film Packs, and Small Sizes of Sheet Film (in Tanks with Removable Reels or Racks)

Fill the tank with developer at the recommended temperature, turn off the light, load the film on the reel, and proceed as follows:

1. Start the timer. Place the loaded reel in the tank containing the developer and secure the lid. Bang the tank sharply on the bottom of the sink or counter several times to dislodge air bubbles that cling to the film.
2. Turn on the lights and begin agitating the film at a rate of about 4 inversion cycles (down, up) every 30 seconds. Each inversion cycle should take about 1 second. If the tank

Control of temperature and humidity contributes greatly to the ease of maintaining proper processing temperature and, in addition, contributes to the comfort of darkroom working conditions.

Agitation of the Developer. Agitation is probably the least understood and the most abused of all the developer controls, even though it is a crucial process that should be used for consistent and uniform results. When agitation is lacking, a stagnant layer of developer and development by-products forms at the interface of the emulsion and the solution. This stagnant layer is partially depleted in the developing agent and is rich in bromide from the developing emulsion. Since bromide is a restrainer that inhibits developer action, the rate of development is retarded unless fresh developer is supplied to the emulsion. On the other hand, if the developing solution is properly agitated, fresh solution is continually brought into contact with the emulsion surface, and the normal development rate prevails.

Lack of agitation also contributes to another processing problem. Without agitation, the stagnant layer, which is heavier than the fresh developing solution, begins to sink slowly toward the bottom of the processing vessel. As it sinks, it tends to leave streaks on the processed negative. *Good* agitation overcomes this tendency toward uneven development.

Line and point images are subject to several *adjacency effects* that can, in part, be traced to insufficient agitation. Such effects often show up as excessively dark edges or as low-density halos outside of dense images. The effects are usually minimized by vigorous agitation throughout development.

In general, *proper agitation is most important for the initial stages of development.* This is the time that the gelatin is swelling and development is just beginning. Unevenness in the distribution of fresh developer at this time usually causes rather severe effects.

Agitation techniques vary, and the particular method used will depend on the manner of development. Agitation should always consist of movements that will not cause a current of solution to flow constantly in any one direction. Such currents create paths of increased density.

Developer Activity. Development of a silver image is a rate process, affected by the chemical composition and activity of the developing solution, the type of emulsion, the temperature, and the agitation conditions. The activity depends upon the constituents of the solution and, particularly, the nature/concentration of the developing agents and the effective alkalinity of the solution. For example, KODAK Developer D-76, with its mild alkaline salt, borax, has a lower rate of development than KODAK Developer DK-60a, which contains KODALK Balanced Alkali. This, in turn, is slower than KODAK Developer D-11, which contains sodium carbonate.

Furthermore, the activity of a developer will be affected by dilution of the solution and its degree of exhaustion. This is especially important when the photographic material being processed is presoaked prior to development. In such a case, the material must be thoroughly drained of all excess solution before it is inserted in the developer.

The developing agent can be depleted by reaction with silver salts, and by aerial oxidation and the build up of development reaction products. A few developing agents are hydrolyzed to inactive products, and developers containing these agents must be prepared and used promptly. These are important considerations in determining the activity of a developer. During development, the developing agent is oxidized as it reduces silver ions to metallic silver, and this loss of developing agent by oxidation contributes to exhaustion of the developing solution. However, the principal cause of developer exhaustion is the accumulation of reaction products that exert a restraining effect on the activity of the solution.

Many unused developing solutions will remain in good condition and usable for reasonable periods of time after preparation provided they are properly stored (see p. 40). However, whenever working solutions in trays or tanks are not in active use, they should be protected from air by covering them with floating covers.

Small quantities of developers are best stored in tightly closed glass bottles. Even then, aerial oxidation may occur if the solution level is low. When only a portion of the contents is taken from the bottle, the air space in the bottle increases and with it the opportunity for oxidation of the remaining solution. A better idea is the storage of developer in glass bottles that contain a volume sufficient for one use only or in collapsible bottles made for photographic processing solutions that allow progressive reduction of the contained solution without increasing the air space.